1 Октомври 2018г.

2. Observation of a star. A star is observed from the Earth. It is found that its magnitude is $m_1 = 2^m.74$ when observed at Zenith and $m_2 = 2^m.85$ when observed at 45° above the horizon. What would the apparent magnitude m_0 of the star be if observed from above the atmosphere (from a satellite, for example)?

1. Sirius. It is known that the so called "Dog Star" (Sirius) is the brightest star in the Chinese sky. And in what else districts on the Earth Sirius is also the brightest star in the real sky of this district? What are numerical characteristics of the borders of these districts? Note: you should take into account only stars in their historical-classical meaning, i.e. Sun, planets, etc. should not be taken into account.

6. The extinction in terrestrial atmosphere.

Extinction is a term used in astronomy to describe light attenuation due to its absorption and scattering.

A star was observed at different zenith distances during one night at the Engelgardt's Astronomical Observatory in the program of atmospheric extinction study at blue. Astronomers use parameter X, air mass, as an extinction characteristic. This parameter corresponds to relative length of the ray's way in the atmosphere. That means X = 1 for zenith, $X = 2/3^{1/2}$ for z = 30°; X = 2 for z = 60° and so on.

The determination of the star's brightness was performed with the method of photon counting. The 3rd column includes number n – the quantity of photons which were detected during one second. A luminescent source was used for calibration the data of observations. It produces a stable flow of photons N = 9900 ± 100 per second, which is equal to magnitude $mb = 9.64^m$ beyond the terrestrial atmosphere.

z	X	n	Δmb
39.7		15135	
45.6		13816	
49.5		13180	
53.0		12246	
54.9		11800	
58.2		10089	

6.1. Draw the table (similar to that you see right) in your answer book. Calculate the air mass for given zenith distances in 1st column, and write the result into the 2nd column.

6.2. Calculate relative magnitude of the star Δmb (blue), and write the result into the 4th column. Use the luminescent source as standard for the relative magnitudes.

6.3. Find functional relation between Δmb and X with a help of graphical method.

6.4. Determine the magnitude of this star as it was observed in zenith.

1. An astronomer on Earth observes a globular cluster, which has an angular diameter α and contains N stars, each one with the same absolute magnitude M_0, and is at a distance D from the Earth. A biologist is in the center of that cluster.

   1.1. What is the difference between the combined visual magnitudes of all stars observed by the astronomer and the biologist. **Consider that the spatial distribution of stars in the cluster is perfectly homogeneous and the biologist is measuring the combined magnitude of the entire cluster.**

   1.2. What is the diameter of the astronomer's telescope, considering he wants to visualize the cluster with the same brightness that the biologist sees?

   1.3. What would be the difference between the visual magnitudes observed by the two scientists, if the diameter of the field of view of the biologist is also α.

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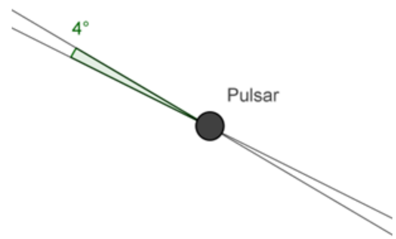
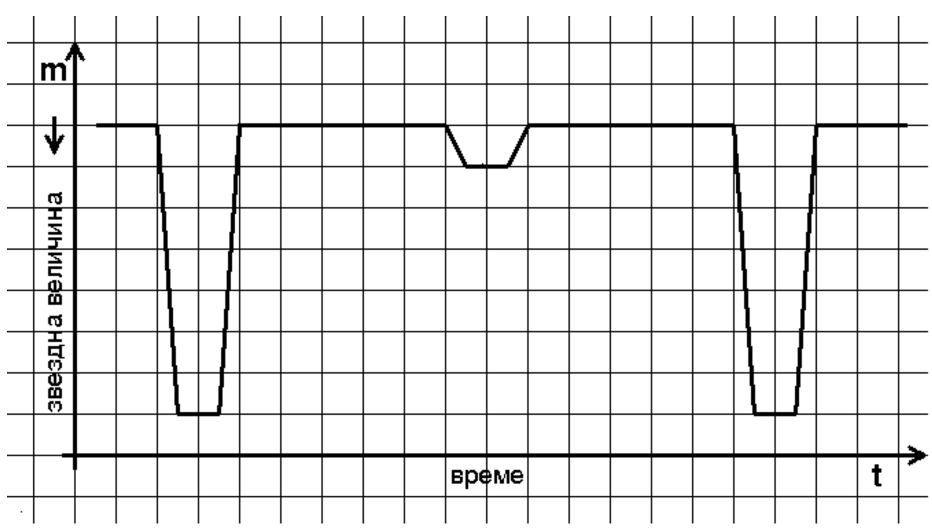
8. A pulsar located 1000 pc far from Earth, 10 000 times more luminous than our Sun, emits radiation only from its two opposite poles, creating an homogeneous emission beam shaped as double cone with opening angle α = 4°. Assuming the angle between the rotation axis and the emission axis is 30°, and assuming a random orientation of the pulsar beams in relation to an observer on Earth, what is the probability of detecting the pulses? In case we can see it, what is the apparent bolometric magnitude of the pulsar?



<u>Задача 4:</u> Нека тясна двойна система се състои от обикновена звезда с малка маса и компактен обект – рентгенова звезда, невидима в оптическата област от спектъра. Често се случва пълната светимост L_X на рентгеновата звезда да е много пъти по-голяма от светимостта L_0 на обикновената звезда. Тогава рентгеновото излъчване, попадащо върху обикновената звезда, нагрява част от повърхността й, което води до променливост в блясъка на двойната система. Пресметнете амплитудата на изменение на блясъка на системата в звездни величини, ако $L_X / L_0 = 500$, а разстоянието между звездите е 4 пъти по-голямо от радиуса на нормалната звезда. Лъчът на зрение лежи в орбиталната равнина на компонентите. Нагрятата част от нормалната звезда преизлъчва в космоса цялата лъчиста енергия, падаща върху нея от рентгеновата звезда. (Наред с едното възможно решение на задачата, съществува и приближено решение с достатъчна точност, при което формулата за площ на отрез от сфера може и да не се използва).

<u>2 задача.</u> На Фиг. 1 е дадена крива на блясъка на затъмнителна променлива звезда. Двете компоненти на системата се движат по кръгови орбити около центъра на масите. Зрителният лъч от земния наблюдател лежи в орбиталната им равнина.

- Температурите на компонентите A и B са TA и TB = 1.8 TA. Определете отношението на техните светимости. Разгледайте всички възможни случаи и представете



Фиг. 1

на схема разположението на двете звезди A и B относно земния наблюдател по време на главния минимум на блясъка на променливата.

- Коя от двете звезди има по-голяма маса и защо?